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their orbits would be almost certain to degrade from ellipses into circles before they got quite clear of the primary. Some would probably be found, when this happens, at the distance of the rings, others within the surface of the primary, none beyond both. Those within the surface of the primary would fall into him and be lost. But one that lay within a ring would gather by its attraction the ring round itself, and so become covered with an immense atmosphere with which it would continue to rotate while advancing in its circular orbit. If this rotation were sufficiently swift, the new planet would throw off rings which might afterwards condense into satellites, with this peculiarity, that they would always keep the same face turned towards the planet, and revolve round it in the same direction and nearly in the same plane in which the planet revolves round its sun.

The speculative element in this hypothesis is so considerable that perhaps we may not prudently yield to it a probability higher than 1. But an hypothesis which carries up so many of the main phenomena of nature to a single source, and which only asks us to admit what is not antecedently improbable, that the number of incandescent stars is but a small proportion of all that exist, seems nevertheless to deserve to be stated.

VI. "Researches on the Hydrocarbons of the Series $C^n H^{2n+2}$.—No. III." By C. SCHORLEMMER. Communicated by Prof. G. G. STOKES, Sec. R.S. Received May 15, 1867.

1. *Di-Isopropyl*, $C_6 H_{14}$.

Iodide of isopropyl is not perceptibly acted upon by sodium even if the liquid is heated to the boiling-point; but if anhydrous ether perfectly free from alcohol is added, a reaction soon commences without application of external heat; the liquid becomes warm, and the iodide is decomposed with formation of iodide of sodium. The chief products of this reaction are, (1) propylene, from which bromide of propylene was obtained by passing the gases which are evolved through bromine; (2) a gaseous hydrocarbon, which is not absorbed by bromine and which burns with a luminous flame, probably consisting of hydride of propyl; and (3) a liquid hydrocarbon, which, according to its composition and mode of formation, must be considered as di-isopropyl. By the following method I obtained the largest yield of this liquid. A flask holding about 250 cub. centims. was half filled with iodide of isopropyl (which had been prepared by acting with hydroiodic acid upon glycerin); an equivalent quantity of sodium cut into thin pieces was added, upon this a layer of pure ether was poured, and the flask quickly connected with the lower end of a Liebig's condenser. Where the two liquids meet, a brisk reaction soon sets in; the escaping gases carry off a large quantity of the liquid, chiefly of the more volatile ether, and it is therefore necessary to keep the condenser as cold as possible. The reaction goes on generally quietly until the greatest portion of the iodide is decomposed; if it stops after a short time, gentle heat has to be applied as long as gas is evolved. After the reaction is over, the

flask is heated in an oil-bath, and the liquid contents are distilled off. The distillate is fractionated several times, and the portion boiling between 50° and 70° C. collected separately. This consists chiefly of di-isopropyl, but also contains ether, undecomposed iodide of isopropyl, and may also contain diallyl if the iodide was not quite pure. In order to remove these admixtures, the liquid is repeatedly shaken with concentrated sulphuric acid as long as heat is evolved, then rectified, and the distillate treated with a mixture of strong nitric and sulphuric acid as long as iodine separates, then washed, dried, and rectified over potassium.

Di-isopropyl is a colourless mobile liquid, the odour of which cannot be distinguished from that of hydride of hexyl, and which boils constantly at 58° C. The specific gravity was found to be

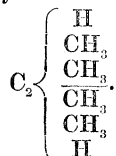
at 10°	C. = 0.6769,
at $17^\circ.5$	C. = 0.6701,
at 29°	C. = 0.6596.

The analysis gave the following numbers:—

0.2390 of substance yielded 0.7315 of carbonic acid and 0.3525 of water,

		Calculated.	Found.
C_6	72	83.72	83.5
H_{14}	14	16.28	16.4
	86	100.00	99.9

The formula for isopropyl now generally accepted is $\begin{Bmatrix} CH \\ CH \\ CH_3 \end{Bmatrix}$, and the constitution of di-isopropyl may therefore be expressed by the following formula:—



This hydrocarbon can be considered as hydride of ethyl, in which 4 atoms of hydrogen have been replaced by methyl and might be called, by accepting the nomenclature for hydrocarbons proposed by Hofmann*, tetramethyl-ethan.

Chlorine attacks this hydrocarbon very easily in the cold, and if the action is stopped before the whole has been acted upon, the principal substitution-product consists of the chloride $C_6 H_{13} Cl$, a colourless liquid which boils constantly at 122° C., and very closely resembles its isomer, chloride of hexyl, the boiling-point of which is 125° C. according to a determination made with the same thermometer. The specific gravity of this chloride is

at 14°	C. = 0.8943,
at 22°	C. = 0.8874,
at 34°	C. = 0.8759.

* Proc. Roy. Soc. vol. xv. p. 57.

The following data give the results of the analysis :—

0·3780 of substance gave 0·4505 of chloride of silver and 0·0023 of metallic silver.

Calculated for $C_6H_{12}Cl_2$.

29·46 per cent. Cl.

Found.

29·7 per cent. Cl.

If iodine is present, the action of the chlorine is quite different. No trace of a monochloride is formed; the chief product consists of bichlorinated di-isopropyl, $C_6H_{12}Cl_2$, a solid substance, besides a smaller quantity of high boiling products, which are very rich in chlorine. From those the solid chloride may be easily separated either by distillation with water, the steam carrying the solid substance very easily over, or by cooling the mixture of the substitution-products and pressing the crystals which separate between blotting-paper. This compound forms white crystals which smell strongly of camphor, and, exposed to the air, soon volatilize at the common temperature; heated in an open tube they sublime below their fusing-point; in a closed tube they melt at about 160° .]

The analysis gave the following results :—

(1) 0·2781 of substance gave 0·4795 of carbonic acid and 0·2030 of water.

(2) 0·1011 of substance gave 0·1846 of chloride of silver and 0·0015 of metallic silver.

(3) 0·1756 of substance gave 0·3136 of chloride of silver and 0·0036 of metallic silver.

(4) 0·1680 of substance gave 0·3040 of chloride of silver and 0·0103 of metallic silver.

(5) 0·1415 of substance gave 0·2515 of chloride of silver and 0·097 of metallic silver.

Calculated.		Found.				
		(1)	(2)	(3)	(4)	(5)
C_6	72	46·45	46·81			
H_{12}	12	7·74	8·11			
Cl_2	71	45·81	..	45·7	44·9	46·6
	155	100·00				46·2

The higher chlorinated products boil under decomposition between 200° and 300° ; the quantity which I obtained was too small to attempt to separate them into definite products

Di-isopropyl is slowly oxidized if it is heated with a concentrated solution of dichromate of potassium and sulphuric acid, a large quantity of carbonic acid being evolved. In order to oxidize 10 grammes of the hydrocarbon it took a week; the liquid was distilled off every day, and the slightly acid distillate neutralized with carbonate of sodium, and thus a sodium-salt was obtained which on recrystallization gave a crop of crystals, whose habitus and reactions were found to coincide with acetate of sodium.

The small quantity of mother-liquor from these crystals was precipitated with nitrate of silver, and the precipitate crystallized from boiling water.

0.2120 of this silver-salt gave 0.1374 of silver, or 64.72 per cent.; acetate of silver contains 64.67 per cent. of silver.

By oxidizing di-isopropyl with chromic acid the only products formed are therefore carbonic acid and acetic acid.

2. *Amyl-isopropyl*, $C_8 H_{18}$.

This hydrocarbon was obtained by acting with sodium and ether upon a mixture of iodide of isopropyl and iodide of amyl. The reaction sets in without applying heat, and is rather violent in the beginning, and it is therefore necessary to keep the flask first immersed in cold water; but to complete the decomposition the mixture has to be heated. When all the sodium has disappeared, the contents of the flask are distilled from an oil-bath, and the distillate is heated with sodium as long as iodide of sodium is formed. Ether and non-attacked iodides are then removed by treating the liquid with strong acids as described above, and thus a mixture of di-isopropyl, amyl-isopropyl, and di-amyl is obtained, from which these hydrocarbons can easily be separated by fractional distillations.

Amyl-isopropyl is a colourless liquid boiling at 109° – 110° ; its specific gravity was found

at $16^{\circ}.5$ C. = 0.6980,

at 49° C. = 0.6712.

The results of the analysis are,—

0.2040 of substance gave 0.6285 of carbonic acid and 0.2900 of water.

	Calculated.		Found.
C_8	96	84.2	84.0
H_{18}	18	15.8	16.1
	<hr/> 114	<hr/> 100.0	<hr/> 100.1

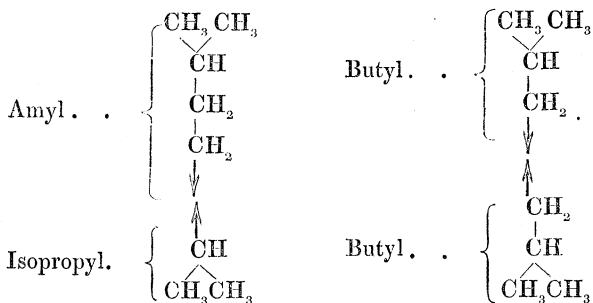
The constitution of this hydrocarbon can be expressed by the formula

$C \left\{ \begin{array}{l} H \\ CH_3 \\ CH_3 \\ C_5 H_{11} \end{array} \right.$, and it might therefore be called dimethyl-amyl-methan. Its

boiling-point and its specific gravity coincide perfectly well with those of dibutyl, which according to Kopp boils at 109° , and has at $16^{\circ}.4$ the specific gravity 0.7001*. I believe that these two hydrocarbons are identical; for Erlenmeyer stated a short time ago in a preliminary note, that he has found that the butyl-alcohol formed by fermentation is methyl-alcohol, in which one atom of hydrogen in the methyl is replaced by isopropyl, and that fermentation amyl-alcohol is ethyl-alcohol, in which also one atom of hydrogen in the methyl group is replaced by isopropyl†. If this view is correct, amyl-isopropyl must be identical with dibutyl, as the following formulæ clearly show:—

* Ann. der Chem. und Pharm. vol. xcv. p. 336.

† Zeitschrift für Chem. N. F. vol. iii. p. 117.



Chlorine converts amyl-isopropyl easily into the chloride $C_8 H_{17} Cl$, a colourless liquid which boils at 165° , and smells faintly of oranges, just as is its isomer, chloride of octyl. Its specific gravity is

at $10^\circ.5 = 0.8834$,

at $36^\circ = 0.8617$.

0.2480 of this chloride yielded 0.2380 of chloride of silver and 0.0015 of metallic silver.

Calculated for $C_8 H_{17} Cl$.

23.90 per cent. Cl.

Found.

23.9 per cent. Cl.

When chlorine acts upon amyl-isopropyl, a mixture of chlorine substitution-products is formed, from which I did not succeed in obtaining definite compounds. On repeated fractional distillation the largest portion passes over between 170° and 180° as a colourless liquid smelling of oranges.

0.2815 of this substance gave on analysis 0.2772 of chloride of silver, which corresponds to 24.36 per cent. of chlorine. This liquid appears therefore to be a mixture of isomeric chlorides of the formula $C_8 H_{17} Cl$.

A solution of chromic acid attacks amyl-isopropyl very slowly; the only oxidation-products which are formed are carbonic acid and acetic acid, from which latter the sodium-salt was prepared, and this was converted into the silver-salt.

0.1985 of this silver-salt contained 0.1291 of silver, or 65.0 per cent., whilst acetate of silver contained 64.67 per cent.

From the commencement of my researches on the hydrocarbons of this series I have tried to obtain definite and characteristic oxidation-products; but the results of these experiments are as yet but very incomplete. I have chiefly studied the action of oxidizing agents upon hydride of hexyl. This hydrocarbon is acted upon by a concentrated solution of chromic acid in the same manner as the two hydrocarbons described above; the only products formed are carbonic acid and acetic acid. A mixture of manganic peroxide and sulphuric acid, as well as a solution of permanganic acid, give only carbonic acid. Nitric acid also forms carbonic acid by boiling it or heating it in sealed tubes with hydride of hexyl; besides, a small quantity of a solid acid, very likely belonging to the oxalic-acid series, is produced. I

have not yet obtained this body in sufficient quantity, as it is only very slowly formed. I hope, however, to find a method to produce it in larger quantities, and also to obtain characteristic oxidation-products of the different hydrocarbons.

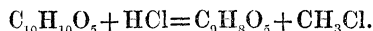
VII. "Researches into the Chemical Constitution of Narcotine and of its Products of Decomposition."—Part II. By A. MATTHIESSEN, F.R.S., and G. C. FOSTER, B.A. Received May 23, 1867.

(Abstract.)

In this memoir the following reactions have been studied:—

1. *The Action of Hydrochloric and Hydriodic Acids on Opianic Acid.*

When strong hydrochloric or hydriodic acid acts at 100° for some time on opianic acid, iodide or chloride of methyl is evolved and a new acid formed,



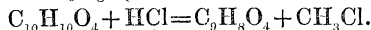
We propose to call this acid methyl nor-opianic acid, as it stands intermediate between opianic acid and the normal opianic acid:—

Normal opianic acid	$\text{C}_8\text{H}_6\text{O}_5$
Methyl nor-opianic acid.	$\text{C}_9\text{H}_8\text{O}_5$
Opianic acid or dimethyl nor-opianic acid. .	$\text{C}_{10}\text{H}_{10}\text{O}_5$

The new acid is soluble in cold water, but much more so in hot, from which it crystallizes on cooling with $2\frac{1}{2}$ molecules of water. Like hypogallic acid it strikes a dark blue with sesquichloride of iron; but on addition of ammonia in excess, a light-red solution is produced, differing, therefore, from the hypogallic-acid blue, with which ammonia becomes blood-red. From the analysis of the silver-salt it appears that methyl nor-opianic acid is monobasic.

2. *The Action of Hydrochloric and Hydriodic Acids on Meconin.*

When meconin is heated with strong hydrochloric or hydriodic acids at 100° for some time, it is split up into chloride or iodide of methyl and an acid of the composition $\text{C}_9\text{H}_8\text{O}_4$. The reaction is



This new acid we may call *methyl nor-meconic acid*, as it stands between meconin and normal meconin:—

Meconin	$\text{C}_{10}\text{H}_{10}\text{O}_4$
Methyl nor-meconin or methyl nor-meconic acid.	$\text{C}_9\text{H}_8\text{O}_4$
Normal meconin.	$\text{C}_8\text{H}_6\text{O}_4$

Methyl nor-meconic acid is soluble in cold, but much more so in hot water; it is easily soluble in alcohol, and slightly so in ether. It reduces solutions of silver-salts in the cold, and behaves with sesquichloride of iron exactly like methyl nor-opianic acid. From the analysis of the barium-salt, methyl nor-meconic acid is monobasic.